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B63B 1/22

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B7A ADH

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(58) Field of search
UK CL (Edition K) B7A ADH AHF, B7V VDA VDB
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(54) **Boat hulls**

(57) A boat hull incorporates a pair of trim tabs 8 mounted symmetrically on the underside of the hull so as to extend l ngitudinally thereof. Each tab is movable between retracted and extended positions. When in the extended position each tab pr sents a surface which serves to redirect wash or spray flowing laterally over the underside of the hull in a downwards dir ction thereby generating a lifting force on the hull and reducing wave resistance. The combined use of longitudinally extending trim tabs with conventional stern tabs can give rise to a significant reduction in drag and improved efficiency. The tabs may be formed of several parts and be mounted as by hinges 9 on an edge of each tab so as to be independently movable by hydraulic actuators.

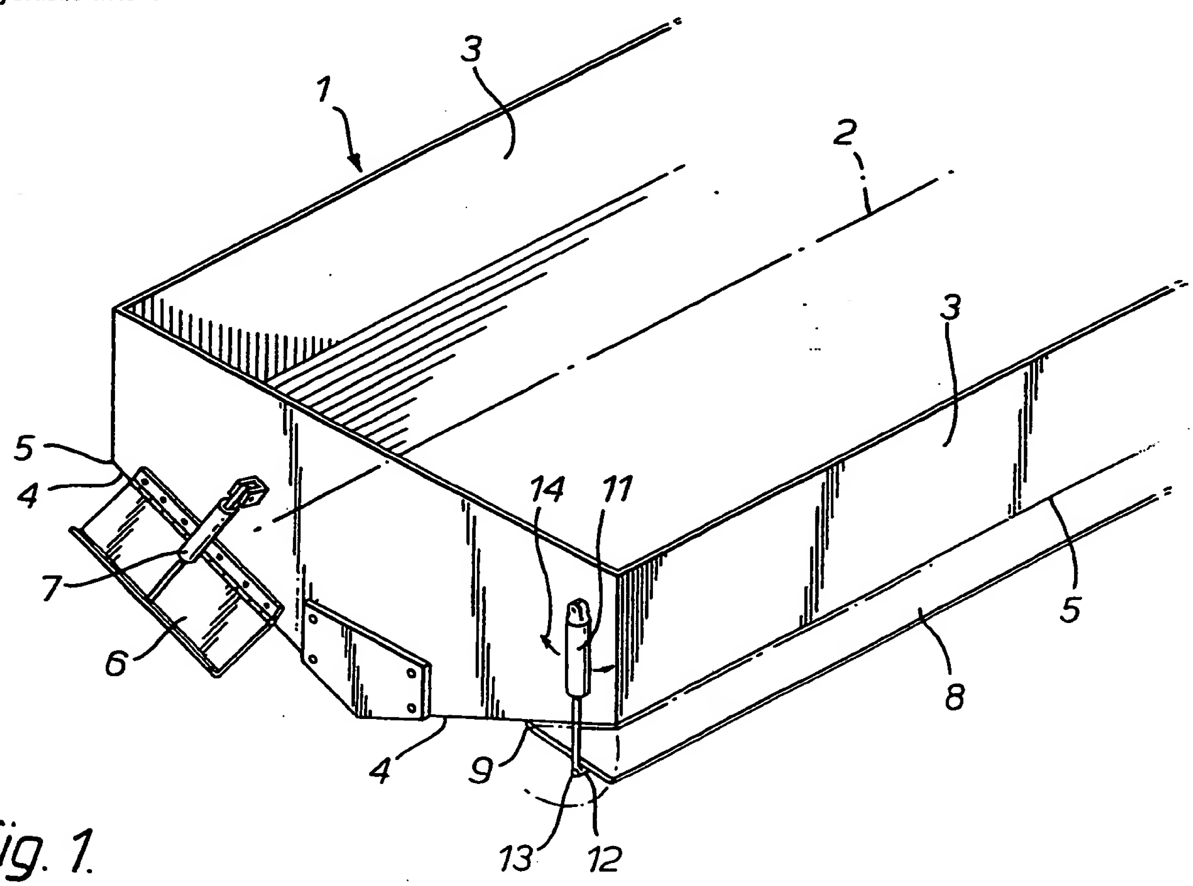

Fig. 1.

At least one drawing originally filed was informal and the print reproduced here is taken from a lat r filed formal copy.

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Fig. 1.

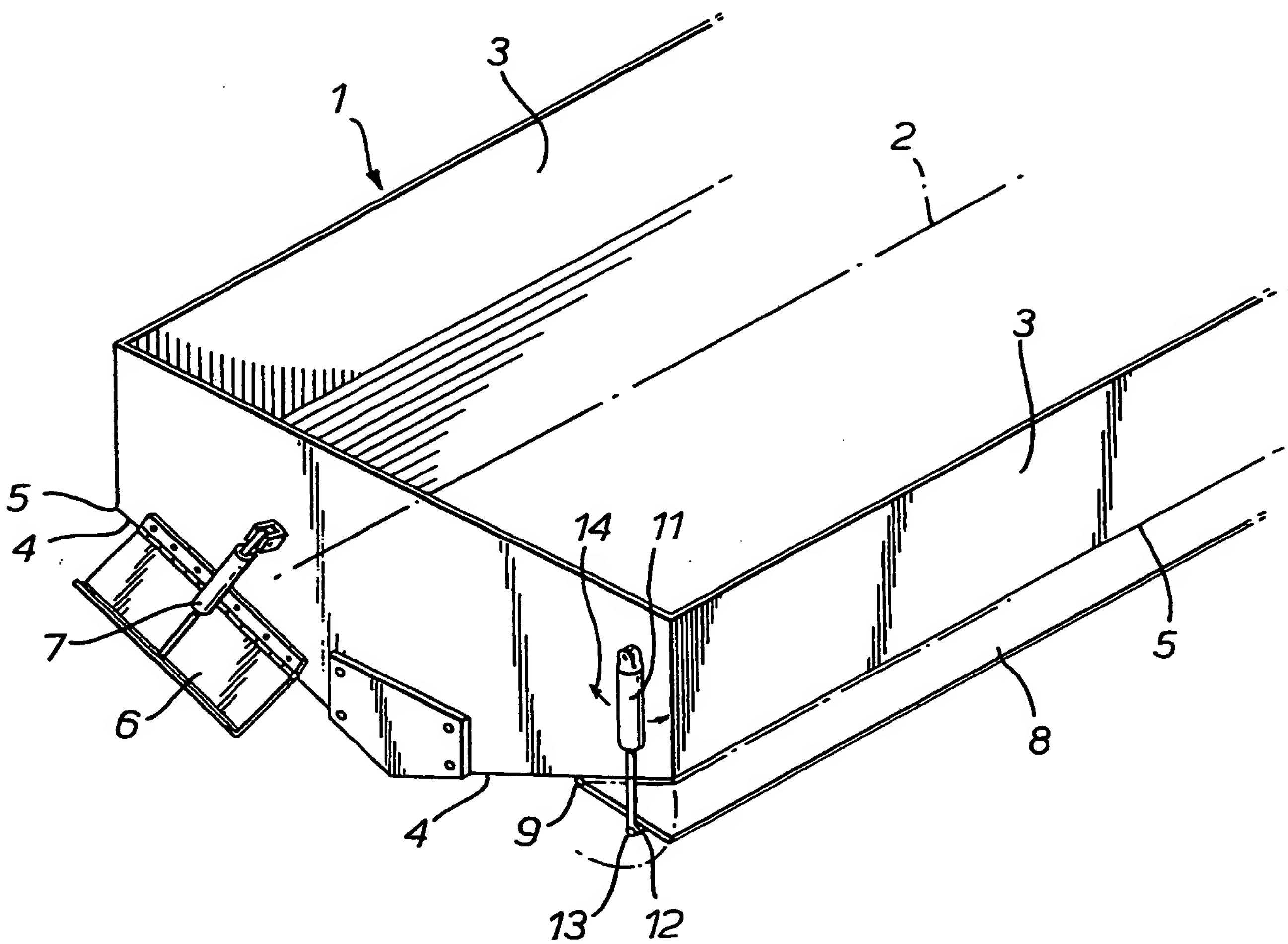

Fig. 2.

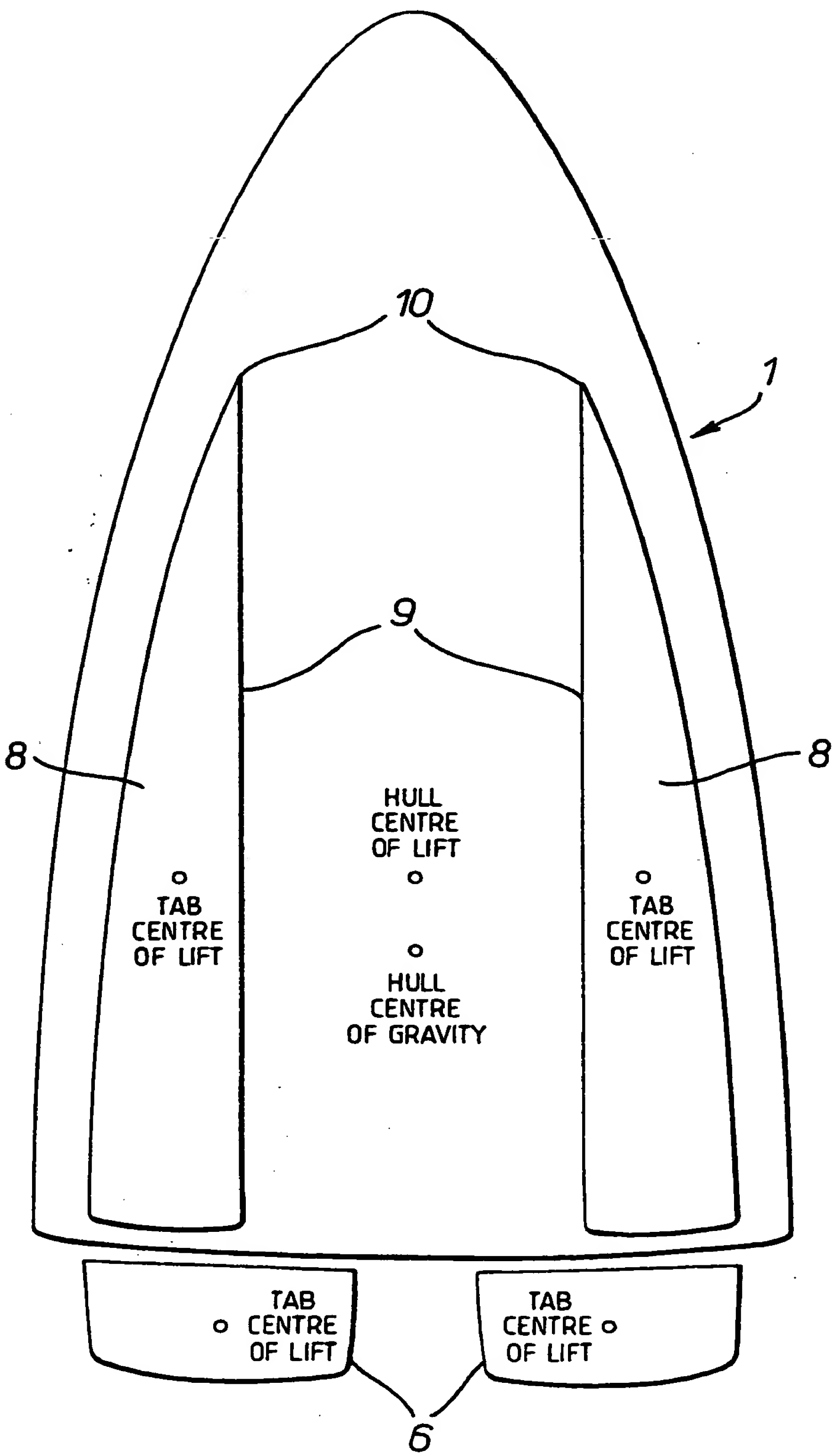
10
9
1
8
8
HULL CENTRE OF LIFT
TAB CENTRE OF LIFT
TAB CENTRE OF LIFT
HULL CENTRE OF GRAVITY
TAB CENTRE OF LIFT
TAB CENTRE OF LIFT
6

Fig.3.

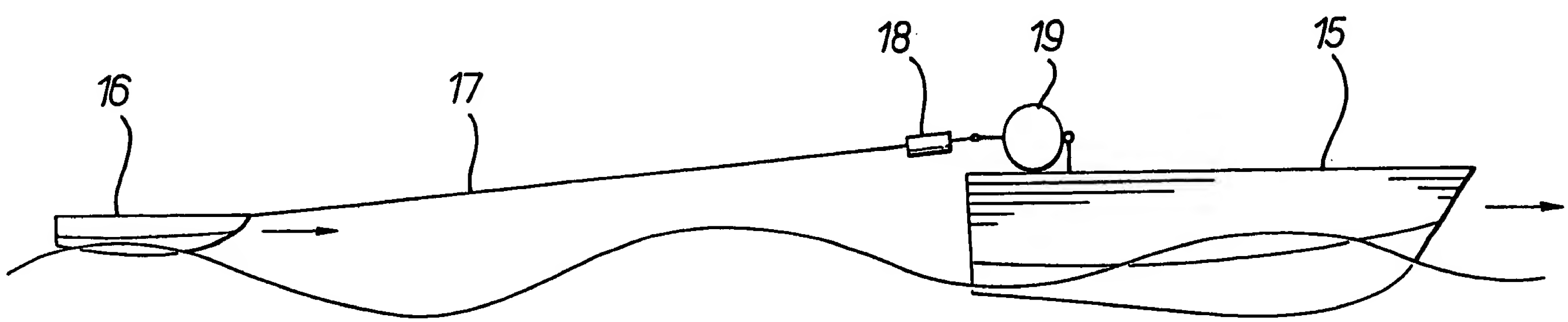

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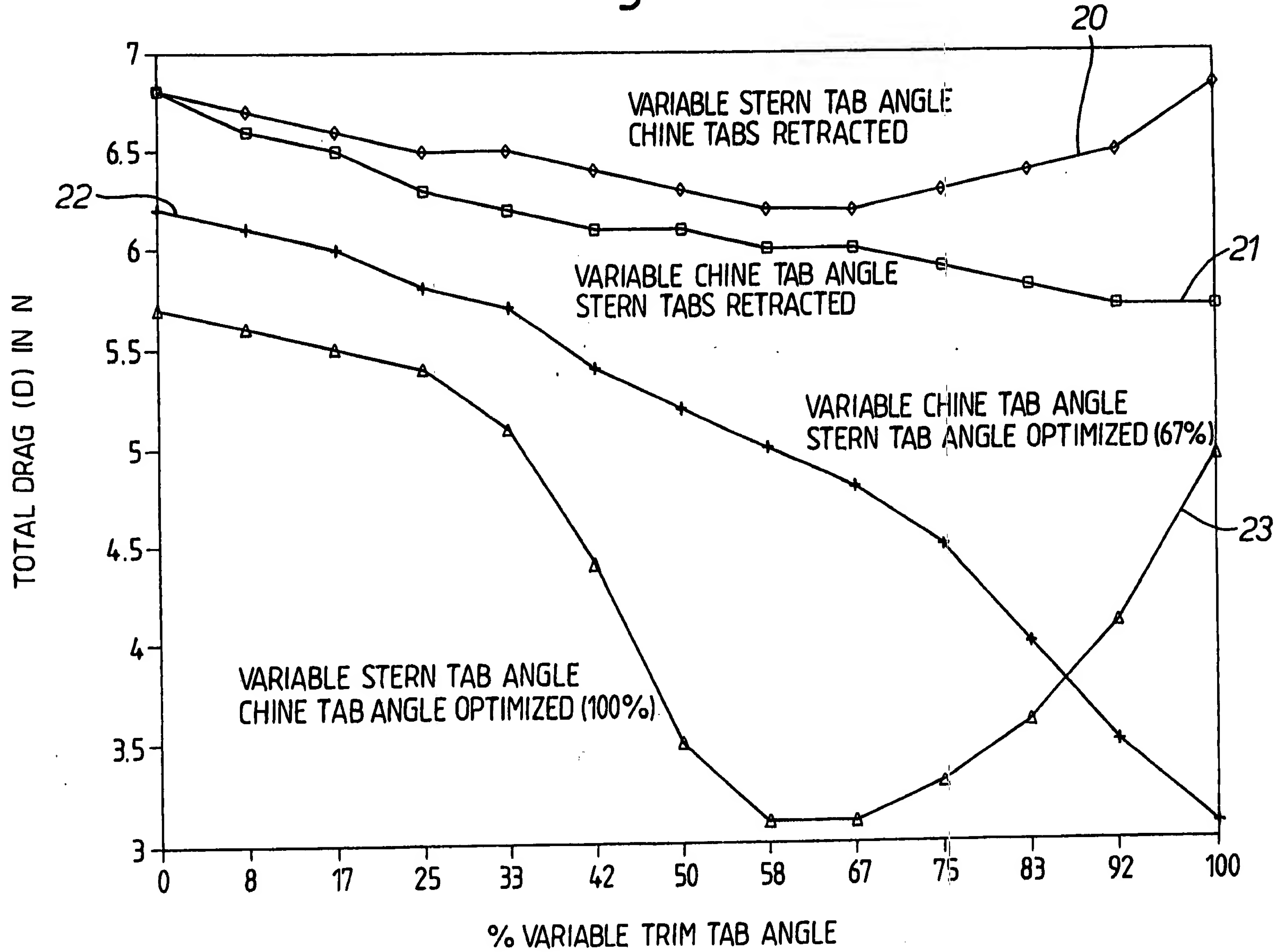
Fig.4.



20
21
22
23
VARIABLE STERN TAB ANGLE
CHINE TABS RETRACTED
VARIABLE CHINE TAB ANGLE
STERN TABS RETRACTED
VARIABLE CHINE TAB ANGLE
STERN TAB ANGLE OPTIMIZED (67%)
VARIABLE STERN TAB ANGLE
CHINE TAB ANGLE OPTIMIZED (100%)
TOTAL DRAG (D) IN N
7
6.5
6
5.5
5
4.5
4
3.5
3
0
8
17
25
33
42
50
58
67
75
83
92
100
% VARIABLE TRIM TAB ANGLE

2262718

DESCRIPTION OF INVENTION

Boat Hulls.

THE PRESENT INVENTION relates to boat hulls.

The design of the hull for a conventional mono-hulled boat is, to a large extent, dictated by the conditions in which the boat is expected to operate. For maximum stability it is desirable for the hull cross-section to define a deep V so that the energy of wave impact is dissipated laterally of the boat in the form of wash or spray in order to give a smoother ride than is experienced if the energy is dissipated vertically generating lift forces on the hull. However, for maximum efficiency it is desirable to generate maximum lift forces in order to raise as much of the hull as possible clear of the water, thereby reducing the frontal and wetted surface areas of the hull and so reducing drag. A greater degree of lift is generated by a substantially flat-bottomed or shallow V hull design.

It will therefore be appreciated that for high performance applications in rough offshore conditions a deep V hull is appropriate. Thus, for example, fast patrol craft and powerboats use this type of hull.

By way of a partial compromise some deep V hulls are provided with pronounced chines (the edge or junction between the sides and the bottom of the hull) in order to regain some lost lift and/or to minimize spray and wash generated, by redirecting some of the wave energy downwards or away from the hull. If the chines of the hull are particularly pronounced then one arrives at what is referred to as a cathedral hull which is a hull having

oversized chines which in some cases may seem almost like additional hulls. The pronounced chines serve to deflect wash and spray downwards thereby generating additional lift and reducing wave resistance. However, viscous drag is increased due to the larger wetted surface area of the hull.

The total drag on a ship's hull can be divided into three components:

There is frictional viscous drag caused by friction between the relatively stationary water and the hull surface moving over it. Secondly there is form or pressure drag which is the result of the energy required in order to force the surrounding water away from the leading surfaces of the hull so as to produce a "hole" in the water through which the hull travels. Thirdly there is wave resistance which is the result of wake, wash and "spray" produced on or above the surface of the water.

At hull velocity to hull length ratios in excess of one (per second) wave resistance is by far the dominant component of drag and increases exponentially with velocity. Wave resistance is the main component of drag experienced by high performance craft and thus any measures which can reduce this resistance would be of particular benefit to such craft.

In an endeavour to reduce the drag on the hull of a boat it is known to provide so-called trim tabs on the stern of the hull. These known trim tabs comprise plate-like elements which are hingedly mounted on the transom at the back of the hull and which may be lowered into the water by means of actuators which may be hydraulic. When lowered the surfaces of the plates

redirect water in a downwards direction which gives rise to an upwards force on the stern of the boat. Thus, the stern trim tabs constitute stern lifting surfaces. Lifting the stern in turn lowers the bow of the boat and thus the angle of attack or the attitude of the boat in the water can be corrected without adjusting throttle setting. This in turn can reduce wake and wash and thereby reduce drag. The existing trim tabs are adjusted by the operator controlling hydraulic rams to vary the depth of the trim tabs in the water until the correct attitude of the boat is achieved. Whilst stern trim tabs are known to reduce the overall drag on the hull of a boat they are only of limited benefit and are dependant upon their correct use by the person operating the boat.

The present invention seeks to provide a boat hull construction which addresses the problems outlined above.

According to this invention there is provided a boat hull incorporating a pair of trim tabs mounted with respect to the hull so as to extend generally longitudinally thereof, and means for moving each tab between a retracted or withdrawn position in which it has little or no affect on the hull form and an extended position in which it presents a surface for redirecting flow moving laterally of the hull so as to generate a lifting force on the hull.

Preferably the trim tabs are elongate and of substantially planar form, the tabs being mounted on the hull in a symmetrical, mirror image arrangement.

Conveniently each tab is mounted on the underside of the hull by means of one or more hinges mounted on an edge of the tab.

Advantageously the or each hinge is mounted on a linear edge of the tab, the linear edge of each tab extending substantially parallel to the longitudinal axis of the hull.

Preferably the edge of each tab opposite the linear edge by way of which the tab is mounted on the hull is of arcuate form and corresponds generally to the plan form of that part of the hull adjacent which it is mounted.

Conveniently the tabs each extend from a position adjacent the stern of the hull over at least 50% of the length of the waterline of the hull.

Each tab may be formed in several parts with the separate parts of each tab being interconnected for relative movement and each being movable independently of the other.

Preferably each tab is independently movable.

Conveniently the means for moving the tabs comprise one or more hydraulic actuators.

Advantageously each tab is infinitely adjustable between the withdrawn and the extended positions.

Preferably the tabs lie substantially flush with the hull when in the withdrawn position.

Conveniently the hull is additionally provided with a pair of stern mounted, transversely extending trim tabs.

This invention also encompasses a boat incorporating a hull as described above.

According to a second aspect of this invention there is provided a fitting for the hull of a boat, the fitting comprising a pair of trim tabs suitable for mounting with respect to the hull so as to extend generally longitudinally thereof, means for mounting the trim tabs on the hull of the boat and means for moving each tab, when mounted on a boat hull, between a retracted or withdrawn position in which it has little or no affect on the hull form and an extended position in which it presents a surface for redirecting flow moving laterally of the hull so as to generate a lifting force on the hull.

In order that the present invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic, perspective view of part of a boat hull as seen from the stern in accordance with this invention;

FIGURE 2 is a schematic plan view of the hull of Figure 1;

FIGURE 3 is a side elevation of an experimental set up for open sea testing of a model boat having a hull in accordance with this invention; and

FIGURE 4 is a graph showing the drag force measured on the model boat shown in Figure 3 for various settings of trim tabs provided on the boat hull.

Referring initially to Figure 1 of the accompanying drawings a boat hull 1 which is symmetrical about a

central, vertical plane containing longitudinal axes 2 has sides 3 and a bottom 4, each side and the bottom joining along a line known as a chine 5. The hull illustrated is of a relatively deep V construction and may, for example, have a dead rise (the angle formed between the bottom of the hull and the horizontal) of approximately 24 degrees, as is commonly adopted in deep V hulls. However the dead rise may, of course, differ.

In Figure 1 of the drawings the two halves of the hull 1 on either side of the vertical plane of symmetry are illustrated as carrying different components. This is for the purpose of illustration only and in practice both halves of the hull would carry components as illustrated on one half only in Figure 1 of the drawings.

Thus, at the rear of the hull, a pair of conventional stern trim tabs 6 are provided, each being associated with a hydraulic actuator 7 by way of which the plate-like tab may be moved. Each tab is, as mentioned, in the form of a plate-like element which is hingedly mounted to the back of the hull. Each tab may be moved between a raised and a lowered position. In the raised position the tabs are angled upwardly from a position in which they would form a planar extension of the bottom of the hull and in the lowered position they are angled downwardly from this datum position so that the under surface of each tab serves to direct water downwardly as the boat moves in a forwards direction and thereby generates a lifting force on the stern of the boat.

In addition to the stern trim tabs 6 a hull in accordance with the present invention is provided with a pair of trim tabs in the form of so-called chine tabs 8 which extend longitudinally of the hull and which are each

mounted on the bottom of the hull at a position relatively close to one of the chines 5. The tabs 8 could, however, be mounted closer to the keel or centre of the hull.

Each tab 8 is substantially planar and is mounted on the bottom of the hull along one edge by means of a piano-type hinge 9. The tabs are mounted symmetrically with respect to the hull in a mirror-image arrangement. When disposed horizontally and viewed in plan each tab 8 has a form as shown in Figure 2 of the drawings. The inwardly directed edge of each tab extends substantially parallel to the longitudinal axis of the hull 1, although it is to be appreciated that the tabs 8 could be mounted on the bottom of the hull so that they are angled relative to the longitudinal axis of the hull, as long as the tabs each extend generally longitudinally. The outwardly directed edge of each tab generally follows the plan form of its associated half of the hull so that overall the tabs are each of a streamlined form, having a very narrow or pointed front end 10 which widens as the tab extends rearwardly so that the tab presents a sufficiently wide surface for redirecting water as will be explained hereinafter.

Each tab extends over a major proportion of the length of the hull and terminates adjacent the transom at the stern of the hull. It is envisaged that each tab will extend longitudinally over at least 50% of the water line length of the hull. The length of the tabs may of course vary and whilst relatively short tabs could be used greater benefits are obtained with longer tabs. The tabs 8 may be formed of any appropriate material. However, the tabs will, it is envisaged, be exposed to substantial torsional and slamming forces when the boat is operational and it is therefore contemplated that the tabs may be formed with a

fibre glass or composite type skin over a foam core construction.

Each tab 8 is movable about the axis of the hinge 9 by way of a hydraulic actuator 11 which extends between the transom at the rear of the hull 1 and a short rearwardly directed projection 12 formed at the rearmost edge of the tab. The rearwardly directed extension 12 is provided close to the outermost edge of the tab 8 and is connected to the arm of the actuator 11 by way of a ball joint 13. The actuator 11 is pivotally mounted on the transom of the hull so as to be movable in a vertical plane in the manner as illustrated by the arrows 14.

Each tab 8 is movable from a raised or retracted position in which it lies flush with the bottom of the hull and in which position it has substantially no affect on the hull form (this position being shown in dotted lines in Figure 1) to a lowered or extended position in which the under surface of the tab serves to redirect wash and spray moving laterally of the hull in a downwards direction so as to generate lifting forces on the hull. In the embodiment illustrated the outer edge of each tab 8 becomes the effective chineof the hull i.e. it forms the point at which lateral flow departs from the hull. Hence the designation 'chine tabs'.

The tabs 8 are each mounted on the hull in such a position that the centre of lift of each tab is longitudinally aligned with the centre of lift of the overall hull. The centre of lift of the hull varies, of course with the attitude of the hull and it is to be appreciated that it is not essential for the centre of lift of each tab to be aligned with the centre of lift of the hull. The hydraulic actuator 11 and the connection between

each actuator and its associated tab 8 permit movement of the tab to any desired position between the fully raised position shown in dotted lines and a lowered position where the actuator is fully extended. Experimental tests have been conducted with the tabs 8 at positions between the fully raised position and a position in which the tab 8 extends substantially at right angles to the bottom 4 of the hull although in practice there is no reason why the tabs could not be lowered further but, at present, the affects of lowering the tabs further are unknown.

At this stage it is to be appreciated that although a description has been given of an integrally formed tab 8 mounted on the underside of the hull by way of a piano hinge 9 the tab form may vary and each tab may even comprise two or more hingedly interconnected sections so that there is a first section extending from the hull to a hinged joint and a second section extending from the hinged joint to a free outer edge of the tab. The two sections of the tab may each be provided with independently driven hydraulic actuators to permit the precise form of the tab to be varied. In addition actuation of the tabs may be effected by means other than hydraulic actuators. Furthermore the tabs need not necessarily be hingedly mounted on the bottom 4 of the hull but may be mounted in other ways. For example, the tab may be mounted so as to be slidably movable from a retracted to an extended position. The tabs could also be mounted on the side or the chine of the hull so as to be movable between a raised position above the waterline and a lowered position. The tabs may be provided so that they can be fitted onto an existing boat hull or may be formed with the hull during construction of the hull itself. It would, of course be possible to provide more than one pair of tabs.

When in the extended position in use the tabs 8 will serve, as mentioned above, to redirect wasted wash and spray energy downwardly so as to produce enhanced hydrodynamic lift and thereby improve hull efficiency by effectively reducing wave resistance without developing additional drag.

Control of movement of the tabs 8 and the stern tabs 6 may be effected in similar manner to methods currently used to control the stern tabs alone, that is to say with the operator adjusting the positions of the tabs in small increments until the desired attitude of the boat is achieved, wake generation is minimized (stern tab control) and wash or spray is also minimized and additional lift is generated (chine tab control). It is envisaged that control of the tabs may also be effected automatically with appropriate sensors detecting pitch or roll of the hull and/or hull acceleration and appropriate adjustment of the relevant tab or tabs being effected by a computer controlled system to maintain optimum tab settings for the prevailing conditions. Automatic control of the tabs would be provided in parallel to manual control so that manual control can always be used to override the automatic control system if necessary.

Whilst it is envisaged that the tabs will usually be adjusted to the same setting it is envisaged that it would be quite possible to control the tabs independently in order to provide a degree of hull stabilisation and to compensate for undesired pitch or roll of the hull.

The sensor for monitoring pitch or roll of the boat hull may comprise a pendulum-type sensor with the suspended pendulum being surrounded by sensors which are contacted when the boat pitches or rolls beyond a predetermined

extent with the sensors activating movement of a particular trim tab or tabs when contacted by the pendulum. Of course, other types of sensor arrangements could be used.

In experimental model tests the use of tabs 8 defining lifting surfaces extending longitudinally of the hull has been shown to reduce drag and therefore improve efficiency. It was already known that the use of stern tabs 6 can reduce drag by minimizing wake and this was also confirmed in the model tests. The tests also showed that the simultaneous use of both stern tabs and "chine tabs" results in a surprisingly high cumulative reduction in drag on the hull which is significantly greater than would be expected from the simple combination of the reduction in drag from the two sets of tabs independently.

Open sea tests were conducted by towing a one metre, 1:10 scale model of a "Cigarette" 35 deep V offshore powerboat fitted with adjustable stern and chine trim tabs. Tests were undertaken in order to determine drag characteristics for various trim tab settings and speed combinations.

The experimental set up is shown in Figure 3. The tests were performed in calm conditions. Sea wave heights were less than 0.5 metres and wind speeds less than 10 ms^{-1}. A 6 metre tow boat 15 of displacement type hull was used to tow a model hull 16 fitted with adjustable stern and chine tabs at speeds up to 4 ms^{-1} with a 20 metre flexible tow line 17 incorporating a spring and frictional damper 18 along its length.

The front end of the spring/damper unit 18 was fixed to the weighing eye of a calibrated, horizontally mounted spring balance 19 mounted at the stern of the tow

boat 15. The spring balance 19 was used to measure the drag experienced by the model hull 16.

The damper was adjusted to minimize shocks and high frequency spring balance deflections due to model hull drag variations as the hull climbed, descended or hit waves, allowing more accurate time-averaged tow line tension and hull drag values to be read.

The height of the mounting position of the spring balance was chosen to provide a tow pull vector on the model hull similar to the thrust vector that such a hull with stern or outboard drives would experience (near horizontal). It should be noted that this pull vector did not vary with the pitch angle of the model hull, as its thrust angle normally would. However, as time averaged drag readings were taken this had no affect on the intended readings.

Appropriate allowances were made for the fact that the model hull was travelling in the tow boat's wake in order to virtually eliminate the effect of the phase of the wake on drag readings.

All the "open sea" tests were performed at Reynolds numbers greater than 1×10^6 to ensure early transition to turbulent boundary layers with late separation, thus providing good correlation with full size hull flow characteristics.

Two sets of drag readings were taken:

Firstly total drag was measured over a range of hull velocities between 1.67 and 4 ms^{-1}. These tests were undertaken with the trim tabs fully retracted and with the

trim tabs at "moderate settings" in order to see whether efficiency gains could be achieved across a wide range of velocities for "moderate" trim tab settings. The stern tabs were set to 10 degrees down from a position in which they would constitute a planar extension of the bottom of the hull and the chine tabs were set to 30 degrees down i.e. 30 degrees from the fully retracted or raised position.

This first set of tests showed that for the tab settings used the total drag measured at any given hull velocity was generally less when the trim tabs were actuated than when they were fully retracted, except for instances when the model hull was "surfing" down the tow boat's wake. Use of the trim tabs resulted in a net hull efficiency gain over the range of velocities tested. The reduced total drag is considered to result from increased lift due to tab deflection of wash and wake downwardly which results in a reduced water phase frontal area. In addition some degree of ram air cushion support may have been generated by air trapped in the two "tunnels" formed between the centre of the bottom of the hull and the chine tabs 8.

A second set of tests were undertaken to measure the total drag on the model hull for different combinations of symmetric trim tab angles at a hull velocity where good efficiency gains had been achieved in the first set of tests referred to above.

The stern tabs 6 were adjustable from 10 degrees up to 20 degrees down from a position in which they would constitute a planar extension of the bottom of the hull. The chine tabs 8 were adjustable from a position flush with the bottom of the hull to a position which they had moved

down through an angle of 90 degrees and were approximately at right angles to the bottom of the hull.

This second set of tests were performed at a Froude number of approximately 0.96 which correlates well with expected full size hull Froude numbers in the region of 1.

The results of this second set of tests are shown in the graph of Figure 4 which plots the total drag on the Y axis against percentage trim tab angle on the axis. For the stern tabs 0% trim tab angle corresponds to the 10 degrees up position whilst 100% trim tab angle corresponds to the 20 degrees down position and for the chine tabs the 0% trim tab angle corresponds to the position in which the tabs are flush with the underside of the hull whilst the 100% angle setting corresponds to the position in which the tabs are substantially at right angles to the underside of the hull.

The top curve identified by reference numeral 20 shows the results obtained when the stern tab settings were varied with the chine tabs being kept in the retracted position flush with the underside of the hull. This curve shows that stern tab angles between 58% and 67% provided the best hull efficiency achievable under these conditions with the chine tabs 8 rendered effective.

The drop in total drag from 6.8N, corresponding to the drag experienced when both the stern tabs and the chine tabs were fully retracted, to 6.2N for the optimized, 67% stern tab setting corresponds to a maximum efficiency gain of 9%.

This efficiency gain was attributed to visibly less wash and wake production (i.e. reduced wave resistance)

derived from reduced frontal area due to an optimized hull angle of attack.

The second curve identified by the reference numeral 21 shows the results obtained when the setting of the chine tabs 8 was varied whilst the stern tabs were fully retracted in the 10 degrees up position. This second curve shows that hull efficiency increased, i.e. drag decreased, almost linearly with the increase in the chine tab angle when the stern tabs were rendered ineffective.

The drop in total drag from 6.8N with all the trim tabs fully retracted, to 5.7N for the optimized, 100% setting of the chine tabs corresponds to a maximum efficiency gain of 16%.

This efficiency gain was attributed to reduced water phase frontal area and therefore reduced wake/wash production (i.e. reduced wave resistance again) due to visibly increased lift, which is thought to have been developed by the redirection of wash downwardly by the chine tabs since expelled wash was reduced.

The third curve identified by the reference numeral 22 shows the results obtained by varying the setting of the chine tabs whilst the stern tabs were kept at the optimized, 67% setting. This curve shows that hull efficiency increases with chine tab setting when the stern tabs were kept at the 67% setting derived from curve 20.

The drop in total drag from 6.8N for all the trim tabs in the retracted position to 3.1N at the 100% chine tab setting corresponds to a 54% reduction in drag.

The fourth curve, identified by the reference numeral 23, shows the results obtained when the stern tab settings were varied whilst the chine tabs were kept at the optimized, 100% setting. As would be expected, this curve again showed a 54% reduction in drag with the stern tabs at the 67% setting.

If the stern and chine trim tab effects were mutually independent and their drag reduction capability was purely additive then efficiency gains of the order of approximately 25% (9% from the stern tabs 6 and 16% from the chine tabs 8) might be expected. However as mentioned above a 54% reduction in drag was achieved and thus some beneficial interaction between the chine tabs 8 and the stern tabs 6 must exist.

One possible explanation for this is that the form drag back-pressure developed by the stern tabs 6 in the "tunnels" formed between the centre of the bottom of the hull and the chine tabs 8 gave rise to greater transverse flow across the chine tabs 8 thereby enhancing their lift characteristics. The chine tabs meanwhile may have enhanced stern tab efficiency by concentrating the main-stream flow beneath the hull over the more effective centre regions of the stern tabs.

This symbiotic trim tab relationship may have been further enhanced by partial ram air cushion hull support if any air entered the "tunnels" defined between the hull and the chine tabs 8, since the back pressure induced by the stern tabs 6 would enhance the air cushion chamber "seal" at the stern of the hull.

It is to be noted that the physical limitations of the experimental model prevented further tests being

conducted with the chine tabs set to positions beyond the 90 degree position and it is therefore possible that even greater efficiency gains could be achieved with the chine tabs set at positions beyond the 90 degree position.

Wind tunnel tests were also undertaken on a scale model and these tests showed that as the setting of the chine tabs 8 was increased from the 0% flush setting back pressure built up along the two "tunnels" established between the hull and the chine tabs and which are effectively bounded at the stern of the hull by the stern tabs 6. This back pressure forced transverse fluid flow across the chine tabs 8, away from the central axis of the hull, over a substantial proportion of the length of the chine tabs. This transverse flow was redirected downwardly by the chine tabs to generate additional lift as the setting of the chine tab angles was increased.

The wind tunnel tests also indicated that the provision of the chine tabs did not significantly impair the fluid flow characteristics over the hull and negligible stagnation, separation and recirculation were detected.

It was not possible to tell from the wind tunnel observations whether the positive affects on hull efficiency would offset the negative affects caused by induced drag due to the back pressure generated in the "tunnels" defined beneath the hull. However, the unexpectedly high additional efficiency gains measured in the towed model investigations suggest that the optimized use of both stern tabs and chine tabs provides substantially net efficiency gains.

Investigations were also made using a self-powered model hull. The observations made indicated that the good

directional stability characteristics of a deep V hull were not degraded by the effectively reduced dead rise due to large chine tab settings and were quite possibly enhanced by the "cutting" outer edges of the chine tabs. Operation of the hull in a straight line or through a turn was found to be enhanced and safe for all symmetric chine tab angle settings whilst the hull was in full planing mode.

It will be appreciated from the details given above that the use of appropriately profiled, symmetrically mounted variable, longitudinally extending lifting surfaces on the underside of the hull of a boat can significantly enhance the presently available stern trim tabs by selectively redirecting wasted wash and spray energy downwardly to develop enhanced hydrodynamic lift and consequently improve hull efficiency without developing additional drag. Energy which is normally lost to wash or spray generation with increasing speed is harnessed by the chine tabs 8 defining the longitudinally extending lift surfaces and provides controlled additional lift and foam hull-lubrication in order to enhance efficiency and stability.

It will be appreciated that the setting of the tabs may be varied as necessary and in accordance with prevailing conditions. The chine tabs effectively make it possible to modify the contour of the hull of a boat during operation so as to obtain the best possible performance from the boat in terms of stability and efficiency dependant upon the prevailing conditions.

Whilst one specific arrangement for the chine tabs 8 has been described and illustrated it will be appreciated that various modifications may be made to this

arrangement without departing from the scope of the present invention.

CLAIMS

1. A boat hull incorporating a pair of trim tabs mounted with respect to the hull so as to extend generally longitudinally thereof, and means for moving each tab between a retracted or withdrawn position in which it has little or no affect on the hull form and an extended position in which it presents a surface for redirecting flow moving laterally of the hull so as to generate a lifting force on the hull.

2. A boat hull according to Claim 1 wherein the trim tabs are elongate and of substantially planar form, the tabs being mounted on the hull in a symmetrical, mirror image arrangement.

3. A boat hull according to Claim 1 or Claim 2 wherein each tab is mounted on the underside of the hull by means of one or more hinges mounted on an edge of the tab.

4. A boat hull according to Claim 3 wherein the or each hinge is mounted on a linear edge of the tab, the linear edge of each tab extending substantially parallel to the longitudinal axis of the hull.

5. A boat hull according to Claim 3 or Claim 4 wherein the edge of each tab opposite the linear edge by way of which the tab is mounted on the hull is of arcuate form and corresponds generally to the plan form of that part of the hull adjacent which it is mounted.

6. A boat hull according to any one f Claims 2 to 5 wherein the tabs each extend from a position adjacent the stern of the hull over at least 50% of the length of the waterline of the hull.

7. A boat hull according to any one of the preceding claims wherein each tab is formed in several parts.

8. A boat hull according to Claim 8 wherein the separate parts of each tab are interconnected for relative movement and are each movable independently of the other.

9. A boat hull according to any one of the preceding claims wherein each tab is independently movable.

10. A boat hull according to any one of the preceding claims wherein the means for moving the tabs comprise one or more hydraulic actuators.

11. A boat hull according to any one of the preceding claims wherein each tab is infinitely adjustable between the withdrawn and the extended positions.

12. A boat hull according to any one of the preceding claims wherein the tabs lie substantially flush with the hull when in the withdrawn position.

13. A boat hull according to any one of the preceding claims wherein the hull is additionally provided with a pair of stern mounted, transversely extending trim tabs.

14. A boat incorporating a hull according to any one of the preceding claims.

15. A fitting for the hull of a boat, the fitting comprising a pair of trim tabs suitable for mounting with respect to the hull so as to extend generally longitudinally thereof, means for mounting the trim tabs on the hull of the boat and means for moving each tab, when mounted on a boat hull, b tween a retracted or withdrawn

position in which it has little or no affect on the hull form and an extended position in which it presents a surface for redirecting flow moving laterally of the hull so as to generate a lifting force on the hull.

16. A boat hull substantially as herein described with reference to and as shown in the accompanying drawings.

~~17. A boat substantially as herein described~~ with reference to and as shown in the accompanying drawings.

18. A fitting for the hull of a boat substantially as herein described with reference to and as shown in the accompanying drawings.

19. Any novel feature or combination of features disclosed herein.

Paten' Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

GB 9127309.4

R levant Technical fields

(i) UK Cl (Edition K) B7A (ADH AHF)
B7V (VDA VDB)

(ii) Int Cl (Edition 5) B63B (1/22)

Search Examiner

B J PRICE

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

14 DECEMBER 1992

Documents considered relevant following a search in respect of claims 1-15

Categ ry (see ver)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2098136 A (ANDERSON) see hinged Sections 8	1 to 3, 9,10,12, 14,15
X	GB 2060502 A (ANDERSON) see hinged Sections 8	1 to 3, 9,10,12, 14,15
X	US 4058077 A (JOHANSSON) see lifting planes 30, 32	1,2,3, 4,6
X	US 3707936 A (HARRIS) see pivoted planes 28 30	1,2,3,4
X	US 3678874 A (FLINK) see whole document	1,2,3,4

Category	Identity of document and relevant passages	Relevant to claim(s)

Cat gori s of documents

X: Document indicating lack of novelty or of inventive step.

Y: Docum nt indicating lack of inventive step if combined with one or more ther docum nts of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present applicati n.

&: Member of the same patent family, corresponding document.

Databases: Th UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as utlined periodically in th Official Journal (Patents). The on-line databases considered for s arch are also listed periodically in the Official Journal (Patents).

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